

SOME UNIVERSITY/INDUSTRY INITIATIVES AT EXXON

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I REPRESENT THE CORPORATE RESEARCH LABS OF EXXON RESEARCH AND ENGINEERING COMPANY, AND I'VE BEEN ASKED TO HIGHLIGHT FOR YOU SOME OF THE INITIATIVES WE'VE RECENTLY TAKEN TO IMPROVE THE LEVEL OF COOPERATION BETWEEN US AND U.S. UNIVERSITIES. I PLAN TO DETAIL FOR YOU OUR RECENT AGREEMENT WITH THE MASSACHUSETTS INSTITUTE OF TECHNOLOGY AND DISCUSS SOME SPECIAL PROGRAMS WE HAVE FOR SUPPORTING OUTSTANDING RESEARCH AND RESEARCHERS. BUT FIRST I WANT TO MAKE A FEW REMARKS ABOUT THE SO-CALLED PROBLEM OF INDUSTRY-UNIVERSITY COLLABORATION.

ALTHOUGH IT IS TEMPTING TO DO SO, I BELIEVE THAT IN THIS AREA WE SHOULD RESIST THE TEMPTATION TO SEEK BROAD GENERALIZATIONS. UNIVERSITIES DIFFER FROM EACH OTHER IN THEIR NEED, ACTUAL OR PERCEIVED, TO COOPERATE WITH INDUSTRY -- AND VICE VERSA. EVEN IN A SINGLE UNIVERSITY, POLICIES CAN VARY FROM DEPARTMENT TO DEPARTMENT. AND THERE IS A VERY WIDE SPECTRUM OF INDUSTRIAL CAPABILITIES AND VARYING DEGREES OF WILLINGNESS TO REACH OUT TO UNIVERSITIES FOR STRONGER COLLABORATION.

SOMETIMES THE PROBLEM IN UNIVERSITY-INDUSTRY RELATIONS IS THAT THE UNIVERSITY PROGRAMS DO NOT CORRESPOND TO THE INDUSTRIAL WORLD'S NEEDS. LET ME GIVE YOU ONE EXAMPLE: IT HAS BEEN POINTED OUT BY PROF. BURWELL AND OTHERS THAT A LARGE FRACTION -- PERHAPS HALF OF THE GRADUATING CHEMISTS WHO GO TO INDUSTRY TEND TO WORK

IN JUST THREE FIELDS -- POLYMERS, CATALYSIS, AND COLLOIDS. AND YET, U.S. CHEMISTRY DEPARTMENTS ARE BY AND LARGE NOT AGGRESSIVE IN RESEARCH IN THESE AREAS. WHILE THE U.S. CHEMICAL INDUSTRY RIGHTLY PERCEIVES THIS AS A PROBLEM IN UNIVERSITY-INDUSTRY RELATIONS, EVIDENTLY THE CHEMISTRY DEPARTMENTS OF UNIVERSITIES DO NOT.

ON THE OTHER HAND, MANY OF THE UNIVERSITIES -- PARTICULARLY THOSE OF MODERATE SIZE -- HAVE WORKED OUT ARRANGEMENTS WITH LOCAL INDUSTRY THAT SERVE THEIR MUTUAL NEEDS. IN THE PROCESS THEY HAVE SOLVED THORNY PROBLEMS SUCH AS THE RIGHT TO INVENTION, FREEDOM OF PUBLICATION, AND OTHER CONCERNS OF ACADEMIA AND INDUSTRY.

SO, I DON'T OFFER YOU GENERALIZED SOLUTIONS. MY BELIEF IS THAT REAL PROGRESS WILL BE MADE BY DEVISING SPECIFIC PROGRAMS TO FIT SPECIFIC ACADEMIC PEOPLE IN A PARTICULAR INDUSTRY-ACADEMIC SETTING.

6 #1 NOW BACK TO OUR MAIN THEME. THE BASIC REASON THAT INDUSTRY SPONSORS RESEARCH ON CAMPUS IS THAT A PARTICULAR UNIVERSITY HAS A UNIQUE ASSET THAT MEETS A PARTICULAR NEED. THESE ASSETS ARE SHOWN ON THE VUGRAPH UNDER THREE HEADINGS: FACULTY, DIVERSITY, AND UNIQUE FACILITIES.

FACULTY MEMBERS CAN PROVIDE AN UNBIASED ANALYSIS OF BROAD OR SPECIFIC PROBLEMS AND CAN TAP THE ENERGIES AND TALENT OF FRESH YOUNG MINDS. FREQUENTLY, THEY HAVE SPECIAL SKILLS OR ACCESS TO SPECIAL EQUIPMENT OR DATA NOT AVAILABLE TO A PARTICULAR CORPORATION.

WHY, THEN, DO COMPANIES OFTEN PREFER TO GO TO THE BATTELLES AND THE ARTHUR D. LITTLES FOR HELP WITH THEIR PROBLEMS?

VG #2

ANSWERS TO THIS QUESTION ARE ROOTED IN INDUSTRY/FACULTY PERCEPTIONS -- BIASES IF YOU WILL -- AND THE DEPARTMENTAL STRUCTURE OF THE UNIVERSITY. SOME FACULTY MEMBERS TEND TO LOOK DOWN ON INDUSTRIAL PROBLEMS BECAUSE THEIR PEERS MAY NOT PERCEIVE THE WORK AS "SCHOLARLY." THEY MAY ALSO WORRY ABOUT A CORPORATE SPONSOR BEING TOO DEMANDING AND THUS LIMITING THEIR INTELLECTUAL FREEDOM. INDUSTRY, ON THE OTHER HAND, MAY SEE LITTLE RELEVANCE -- EVEN LONG TERM -- IN THE WORK THE ACADEMICIAN WOULD LIKE TO HAVE FUNDED AND MAY WORRY ABOUT THE SAFEGUARDING OF PROPRIETARY INTERESTS. BARRIERS TO UNIVERSITY-INDUSTRY INTERACTIONS CAN ALSO ARISE FROM THE NATURE OF THE TWO ORGANIZATIONS. IN THE UNIVERSITY, ONE HAS TO WORRY ABOUT TENURE. IN INDUSTRY, ONE FREQUENTLY NEEDS TO MOUNT AN INTERDISCIPLINARY ATTACK ON A PROBLEM, WHILE THE DEPARTMENTAL STRUCTURE OF THE UNIVERSITY LENDS ITSELF TO A NARROWER FOCUS.

ANOTHER GENERAL PROBLEM IS THE DECLINING ENROLLMENTS OUTLOOK FOR THE UNIVERSITIES. AS DEAN ROSKOVSKY OF HARVARD HAS OBSERVED, THE RESULTING SHORTAGE OF ACADEMIC POSTS UNTIL 1995 IS SO ACUTE THAT THE NEEDS OF ACADEME CAN BE MET BY THE OUTPUT OF A SINGLE MAJOR GRADUATE SCHOOL. PART OF THE PROBLEM THIS CREATES, SUGGESTS E. PATRICK MCGUIRE OF THE CONFERENCE BOARD IS THAT THE U.S. IS NOW CONFRONTED WITH A RELATIVELY STATIC SCIENTIFIC EMPLOYMENT PICTURE AT THE UNIVERSITY LEVEL. THE RESULTING AGING OF THE SCIENTIFIC FORCES IN THE BASIC RESEARCH UNITS OF THE UNIVERSITY AND THE POSSIBLE IMPLICATIONS ARE WORTH NOTING.

FUNDING WISE, STATISTICS COMPILED BY THE NATIONAL SCIENCE FOUNDATION SHOW THAT THE INCREASED DEPENDENCE OF UNIVERSITY RESEARCH AND GRADUATE PROGRAMS ON FEDERAL SUPPORT THAT ACCELERATED SINCE WORLD WAR II FELL OFF SOMEWHAT IN THE EARLY 1970'S IN REAL TERMS. SINCE 1977, HOWEVER, FEDERAL SUPPORT HAS AGAIN SHOWN YEAR-TO-YEAR INCREASES IN REAL TERMS. AND THE LATEST WORD IS THAT FISCAL 1981 WILL BE NO EXCEPTION, WITH GOVERNMENT FUNDING NOW EXPECTED TO TOP \$5 BILLION IN CONSTANT DOLLARS. RECENT STATISTICS SHOW THAT ABOUT TWO-THIRDS OF UNIVERSITY RESEARCH FUNDING COMES FROM U.S. GOVERNMENT AGENCIES AND ONLY 3% FROM INDUSTRY. AS A RESULT, A GENERATION OF PROFESSORS HAS BECOME ADDICTED TO ACRONYMS: THE DOD, DOE, EPA, NIH, NSF, NASA AND ON AND ON.

BUT GOVERNMENT FUNDING SEEMS TO BE REQUIRING MORE AND MORE RED TAPE. LET ME QUOTE FROM AN AUGUST 1980 ARTICLE FROM SCIENCE ENTITLED "INNOVATION AND SCIENTIFIC FUNDING." THE AUTHOR, RICHARD A. MULLER, IS PROFESSOR OF PHYSICS AT THE UNIVERSITY OF CALIFORNIA, BERKELEY.

"WHEN I BEGAN RESEARCH IN 1965," HE STATES, "OUR RESEARCH GROUP OFTEN RECEIVED MORE THAN THE MINIMUM SUPPORT NECESSARY FOR OUR PROJECTS...BY 1972 OUR PROPOSALS WERE SCRUTINIZED TO ENSURE THAT WE RECEIVED NO MORE THAN THE NECESSARY MINIMUM...BY 1976 FEW OF OUR PROPOSALS RECEIVED ENOUGH MONEY EVEN TO SUSTAIN A PROJECT, AND WE HAD TO OBTAIN SUPPORT FROM MORE THAN ONE AGENCY. MUCH OF THE TIME WE HAD DEVOTED TO THINKING ABOUT NEW PROJECTS WAS NOW SPENT WRITING AND POLISHING PROPOSALS...THE MOST FUNDAMENTAL MISTAKE MADE BY FUNDING AGENCIES IS IN ASSUMING THAT THE ABILITY TO WRITE GOOD PROPOSALS IS EQUIVALENT TO THE ABILITY TO ACCOMPLISH GOOD RESEARCH."

I KNOW FROM EXPERIENCE THAT IT IS NOT UNUSUAL FOR THE DRAFTING, "SELLING" AND ADMINISTRATING OF A SINGLE PROPOSAL TO TAKE AT LEAST ONE-FOURTH OF A MAN YEAR. TODAY'S ACTIVE RESEARCH PROFESSORS MAY EASILY SPEND 25% OF THEIR TIME ON THE ADMINISTRATIVE REQUIREMENTS OF SECURING AND MAINTAINING A GOVERNMENT CONTRACT.

THE INITIATIVES WE'VE UNDERTAKEN IN OUR CORPORATE RESEARCH LABS ARE INTENDED TO PROVIDE THE UNIVERSITY RESEARCHER THE OPPORTUNITY TO PURSUE MEANINGFUL RESEARCH ON THE FRONTIERS OF SCIENCE WITHOUT COMPROMISING SCIENTIFIC FREEDOM OF INQUIRY AND INTEGRITY, AND WITH RELATIVELY LITTLE RED TAPE. LET ME EMPHASIZE THAT THE PROGRAMS I WILL BE DESCRIBING ARE SPECIFIC TO CORPORATE RESEARCH. THERE ARE OTHER PROGRAMS WITHIN EXXON RESEARCH AND ENGINEERING COMPANY AND WITHIN OTHER EXXON COMPANIES AND AFFILIATES. GENERALLY, THESE ARE RESPONSIVE TO THE PARTICULAR NEED OF EACH ORGANIZATION. THE EXXON EDUCATION FOUNDATION ALSO SUPPORTS NUMEROUS EDUCATION PROGRAMS AND ACTIVITIES. ITS 1980 APPROPRIATIONS OF OVER \$16 MILLION, HOWEVER, DO NOT INCLUDE THE DIRECT FUNDING ACTIVITIES OF THE VARIOUS ORGANIZATIONS UNDER THE EXXON UMBRELLA.

NOW, LET ME TURN TO SPECIFICS.

G #3 LAST SPRING, M.I.T. AND EXXON RESEARCH AND ENGINEERING COMPANY ANNOUNCED A 10-YEAR RESEARCH AGREEMENT IN THE FIELD OF COMBUSTION SCIENCE. COMBUSTION WAS A PROMISING CANDIDATE FOR LONG-TERM RESEARCH BECAUSE EXXON HAS BEEN PARTICULARLY INTERESTED IN THE COMBUSTION WORK BEING CONDUCTED BY PROFESSORS JOHN P. LONGWELL AND ADEL F. SAROFIM. BOTH PROFESSORS HAVE WORLDWIDE REPUTATIONS IN THE FIELD.

THE PROGRAM'S MAJOR OBJECTIVES ARE TO HELP GENERATE THE SCIENTIFIC BASE FOR THE MORE EFFICIENT AND ENVIRONMENTALLY ACCEPTABLE BURNING OF HIGH SULFUR, HIGH NITROGEN, HYDROGEN-DEFICIENT FOSSIL FUELS SUCH AS COAL, COAL LIQUIDS, SHALE OIL AND HEAVY CRUDE OIL. WHAT WE ARE LOOKING FOR IS NEW UNDERSTANDINGS.

THE INITIAL TEN-YEAR LIFE OF THE AGREEMENT ASSURES THAT LONG-RANGE RESEARCH INITIATIVES WILL HAVE FINANCIAL CONTINUITY AND STABILITY. WE EXPECT OUR SUPPORT OVER THE LIFE OF THE AGREEMENT WILL TOTAL BETWEEN \$7 AND \$8 MILLION. TO MAKE SURE THAT NO GRADUATE STUDENT WILL BE LEFT IN THE MIDDLE OF HIS THESIS, EITHER PARTY MUST GIVE THE OTHER TWO YEARS' WRITTEN NOTICE TO TERMINATE THE AGREEMENT.

EIGHTY PERCENT OF THE FUNDS WILL BE USED FOR MUTUALLY AGREED UPON PROJECTS. AN ADDITIONAL 20 PERCENT WILL BE MADE AVAILABLE BY EXXON TO PROFESSORS LONGWELL AND SAROFIM FOR ANY COMBUSTION SCIENCE RESEARCH OF THEIR CHOOSING. THESE PRINCIPAL INVESTIGATORS WILL DEVOTE ABOUT HALF OF THEIR TIME TO PROJECTS UNDER OUR AGREEMENT. THEY WILL ALSO INTERFACE WITH OTHER M.I.T. SCIENTISTS AND ENGINEERS AND FELLOWS OR STUDENTS WORKING ON ONE OF THE DESIGNATED OR DISCRETIONARY PROJECTS. AND ALONG WITH TWO REPRESENTATIVES OF EXXON RESEARCH AND ENGINEERING, THEY WILL DEVISE PROCEDURES, INITIATE PROJECT CHANGES AS NEEDED, HAVE STEWARDSHIP FOR THE ANNUAL BUDGET, AND OVERSEE THE FILING OF PATENTS.

M.I.T. HAS THE RIGHT TO FILE PATENTS ON ALL TECHNOLOGY DEVELOPED AS A RESULT OF THE RESEARCH AND WILL HANDLE THE LICENSING OF ALL THIRD PARTIES. WE WILL SHARE IN THE ROYALTY INCOME AND ALONG WITH OUR AFFILIATES RECEIVE AN IRREVOCABLE, WORLDWIDE, NON-EXCLUSIVE,

VG #4

ROYALTY-FREE LICENSE FOR USE OF THE PATENTED TECHNOLOGY. ALSO, SHOULD M.I.T. ELECT NOT TO FILE FOR A PARTICULAR PATENT, ER&E CAN. ALL RESULTS WILL BE PUBLISHED PROMPTLY AND OPENLY. THERE IS AN OBLIGATION TO SUBMIT MANUSCRIPTS TO BOTH M.I.T. AND TO EXXON, BUT THERE ARE ALSO PROVISIONS THAT MAKE IT IMPOSSIBLE TO SHELVES A MANUSCRIPT.

OUR REQUIREMENTS FOR PERFORMANCE AND REPORTING UNDER THIS AGREEMENT DEMONSTRATE THAT WORKING WITH INDUSTRY CAN BE LESS BURDENSOME THAN WORKING FOR A TYPICAL FEDERAL SPONSOR, AT LEAST ACCORDING TO PROF. LONGWELL.

THIS AGREEMENT IS ONE WAY, NOT THE WAY FOR A UNIVERSITY AND COMPANY TO WORK TOGETHER. THE MORE APPLIED THE FIELD OF STUDY AND THE CLOSER IT FALLS TO AN INDUSTRIAL SPONSOR'S CHIEF COMMERCIAL INTERESTS, THE MORE DIFFICULT IT WILL BE TO COME TO AN ACCEPTABLE COMPROMISE.

HAVING EXAMINED THE EXXON/M.I.T. AGREEMENT, LET ME SHARE WITH YOU SOME GENERAL PRINCIPLES THAT WE APPLY TO THE SELECTION OF A UNIVERSITY PARTNER. FIRST, OUR FOCUS IS ON PEOPLE BECAUSE A SUCCESSFUL PARTNERSHIP DEPENDS ON WHETHER YOU CAN FIND AN AREA OF MUTUAL INTEREST. WE ARE PRIMARILY INTERESTED IN RESEARCHERS WHO MAKE UP ACADEMIC CENTERS OF EXCELLENCE, RATHER THAN IN THIS OR THAT INSTITUTION. SECONDLY, FUNDING IS OFTEN NOT THE ISSUE, RATHER IT IS THE ATTITUDES AND PRACTICES WITHIN THE UNIVERSITY COMMUNITY. FOR EXAMPLE, WE HAVE A TOUGH TIME INTERESTING CHEMISTS IN WORKING ON COMPLEX CHEMICAL AND PHYSICAL SYSTEMS SUCH AS COAL. UNIVERSITY CHEMISTS PREFER MORE EASILY CHARACTERIZABLE SYSTEMS. AND SO DO CHEMISTRY JOURNALS.

NOW THAT I'VE GIVEN YOU A LOOK AT THE M.I.T. AGREEMENT AND PHILOSOPHIZED A LITTLE, LET ME BRIEFLY DESCRIBE SOME OF THE OTHER UNIVERSITY-INDUSTRY INITIATIVES WE HAVE UNDERWAY IN ER&E'S CORPORATE RESEARCH LABORATORIES.

VG #5

WE HAVE AN UNRESTRICTED GRANTS PROGRAM AIMED AT PROVIDING MONIES FOR INDIVIDUAL FACULTY MEMBERS SINGLED OUT BY OUR SCIENTISTS AS OUTSTANDING OR FOR GRADUATE FELLOWSHIPS IN DEPARTMENTS WHERE THESE PEOPLE WORK. THE AVERAGE SIZE OF A GRANT IS \$10,000 TO \$15,000; IT IS GIVEN FOR THREE YEARS AND IS RENEWABLE ANNUALLY. ADMINISTERED BY THE EXXON EDUCATION FOUNDATION, THE PROGRAM BEGAN IN 1978 WITH ABOUT \$300,000 AND BY 1980 THE TOTAL HAD GROWN TO ABOUT \$500,000. NOMINATIONS OF GRANT RECIPIENTS ARE MADE BY OUR CORPORATE RESEARCH SCIENTISTS. THIS SELECTION BY THE WORKING-LEVEL SCIENTIST IS, I BELIEVE, A NOVEL AND IMPORTANT FEATURE OF THE PROGRAM.

VG #6

ANOTHER PROGRAM WE HOPE TO GET STARTED IS TO TRY TO SINGLE OUT THE PROMISING YOUNG PROFESSOR WORKING FOR TENURE. THIS IS THE CRITICAL CAREER POINT WHERE HE OR SHE MOST NEEDS SUPPORT. IT SHOULD COME AS NO SURPRISE THAT WE WILL CONCENTRATE ON IDENTIFYING YOUNG TALENT IN THOSE FIELDS THAT WE HAVE IDENTIFIED AS IMPORTANT TO US. THESE FACULTY MEMBERS WILL RECEIVE AWARDS DESIGNATED AS EXXON FELLOWSHIPS. THE AWARDS WILL BE AS INFORMAL AS WE CAN POSSIBLY MAKE THEM.

AN ADDITIONAL INITIATIVE WHICH IS ALREADY UNDERWAY IS A PROGRAM OF VISITING UNIVERSITY SCIENTISTS. DURING 1980 THERE WERE ABOUT EIGHT SUCH DESIGNEES WHO WORK WITH US FOR 1-2 YEARS. WE COVER THE SPECTRUM FROM SENIOR PRE-DOCTORATES TO POST-DOCS AND VISITING PROFESSORS.

LET ME RETURN TO THE POINT I MADE AT THE BEGINNING. THERE ARE, OF COURSE, SOME GENERAL ISSUES THAT REQUIRE MORE COOPERATION BETWEEN THE UNIVERSITY TECHNICAL INDUSTRY. BUT REAL PROGRESS WILL BE MADE, IN MY VIEW, BY FOCUSING ON SPECIFICS -- THAT IS, SPECIFIC PEOPLE AND SKILLS, SPECIFIC OBJECTIVES OF THE COOPERATION, AND THE PARTICULAR IMPEDIMENTS THAT APPLY IN A GIVEN SITUATION. NEW AGREEMENTS CAN THEN EMERGE, NEW INITIATIVES THAT WORK. OTHERS WILL SEE THAT THEY WORK, AND WILL ADAPT THEM TO THEIR OWN SITUATION. WHAT I'VE DISCUSSED TODAY REPRESENTS OUR OWN ATTEMPTS TO WORK THE PROBLEM, AND I HOPE WHAT WE'VE LEARNED WILL BE USEFUL TO YOU.

PJL/EJP

12/24/80

BARRIERS TO UNIVERSITY— INDUSTRY INTERACTION

Faculty Perceptions

- Industry problems are not “scholarly”
- Corporate sponsor may taint judgment, inhibit freedom

Industry Perceptions

- Leisurely time frame of academic progress little relevance
- Rapid turnover of (student) workforce
- Safeguarding of proprietary interest

Structural Barriers

- Industry work may not help tenureship
- Difficult for university departments to cooperate and field interdisciplinary effort

POTENTIAL UNIVERSITY ASSETS OF USE TO CORPORATION

Faculty

- **As consultants**
- **Independent analysis of industry-wide problems (e.g., energy modeling study)**

Diversity

- **Skill groups that company doesn't have**
- **Potential to tackle multidisciplinary problems**
- **Temporary (student) help**

Unique Facilities

- **Technical equipment**
- **Wider data base (incl. library)**

KEY FEATURES OF THE ER&E/M.I.T. RESEARCH AGREEMENT

Major Objectives

- **Helps generate scientific base for new combustion technology**

Funding

- **Provides support for up to 10 years**
- **Assures stability for long-range research efforts**

Designated Projects

- **Devotes 80% of the funds to jointly selected projects**

Discretionary Projects

- **Channels 20% of the funds to M.I.T. selected research**

ER&E/M.I.T. AGREEMENT (CONTINUED)

Manpower

- **Commits 50% of the time of the principal investigators**

Administration

- **Consists of two representatives each from M.I.T. and ER&E**
- **Establishes procedures, oversees projects and budgets**

Patents

- **Files on the technology developed (M.I.T. and/or ER&E)**
- **Grants non-exclusive licenses to third parties**
- **Gives Exxon and its affiliates a royalty-free license**

Publications

- **Encourages the prompt and open publication of all results**

EXXON CORPORATE RESEARCH UNRESTRICTED GRANTS—1980

<u>Science Area</u>	<u>Institution</u>	
Catalysis	Harvard	
Chemical Engineering	Delaware	Wisconsin
Chemistry	Cal.-Berkeley	Harvard
	Cal. Tech.	Illinois
	Chicago	M.I.T.
	Cornell	Wisconsin
Coal Science	Houston	Tennessee
Interfacial Science	Minnesota	
Laser Science	Princeton	
Materials Science	Cal.-Berkeley	
Physics	Cal.-San Diego	Illinois
	Chicago	Penn State
	Harvard	Stanford
Polymer Science	Akron	Massachusetts

OTHER UNIVERSITY INTERACTIONS

Exxon Fellowships

- Informal awards for young professors

Visiting Scientists

- Pre-docs, post-docs and visiting professors

Exxon Faculty Fellow

- Five-year appointments for outstanding scientists

University Visits

- Visits by ER&E scientists to universities

Consultants

- Nonproprietary discussions (about 200 in 1989)
- Proprietary, contractual discussions (about 50 annually)